THURSDAY, JULY 19, 1877

THE "INFLEXIBLE"

IN our last number we sketched in outline the scientific principles and considerations which lie at the foundation of the important question now at issue regarding the *Inflexible*.

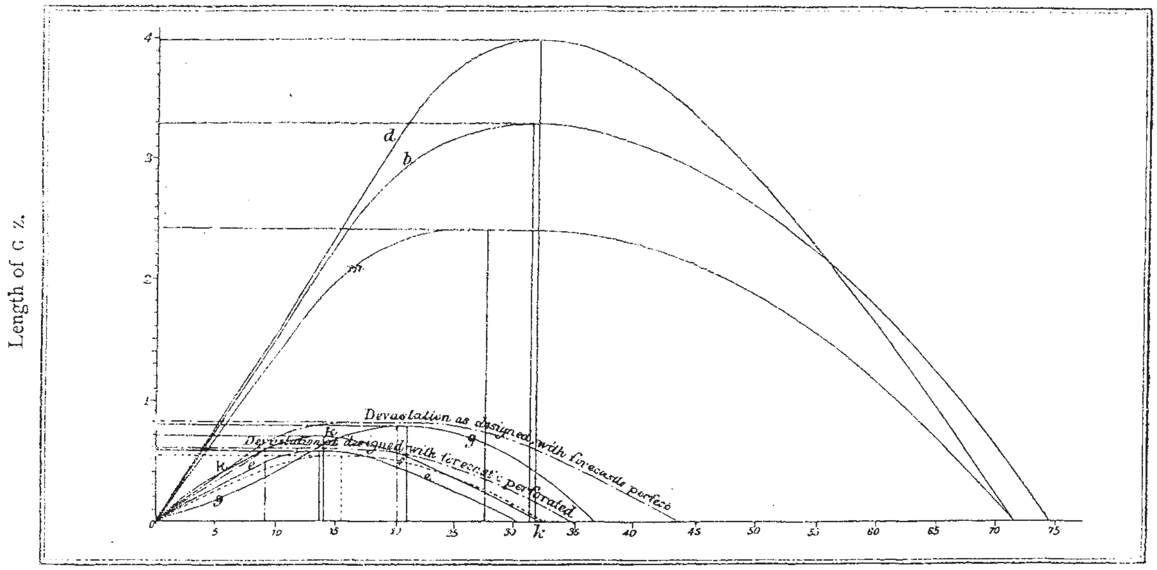
We now proceed to consider the case as set forth in the papers which have since been presented. The fact of a Committee having been appointed to investigate it is no reason for our passing over in silence these papers, which have been already laid upon the table of Parliament expressly to disseminate the information contained in them. We shall not, however, seek to trench in any degree upon the duties undertaken by the Committee.

The first question to be asked is the vital one—What stability is claimed by the Admiralty for the *Inflexible* in the condition contemplated by the *Times* and Mr. Reed, and, as is now made perfectly clear by the papers, by the Admiralty office itself when the ship was designed, a condition namely in which the unprotected ends were so far injured as to cease to contribute stability to the ship?

Has the ship that range of 50 deg. which, as we saw last week, the Committee on Designs, as a result of scientific consideration laid down as necessary for a mastless ship exposed to the action of the sea? Has she even that 39 deg. which is the very lowest amount ever mentioned as compatible with safety? And, it must be further asked (since "range" alone is a most insufficient guide to safety), is the *amount* as well as the *range* such as the settled science of the subject would demand? None of these answers lie on the surface of the Parliamentary papers, and some of them are not to be found there at all; but by what Dr. Schliemann would call "the pickaxe method" of investigation, we can get at part of them, and infer the remainder with all necessary certainty. The most difficult and unfortunate part of the inquiry is due to the fact that the *apparent* answers that do lie on the surface are not the true ones, although they bear every outward semblance of being so. The scientific world is turning to these papers for one piece of information before and beyond all others, namely, this very stability of the *Inflexible* with "unarmoured ends giving no stability;" and when they get to p. 10 there they find it plainly set forth, in tabular form, and in full detail: "Maximum stability 6,532 foot-tons; angle of maximum stability 13½ deg.; range 30 deg.;" and reading this they begin to say to themselves that although the ship is, on the showing of her constructor, below the standard of safety which everybody has either laid down or accepted, yet that she is not so alarmingly deficient as they had supposed from the pronounced tone of her critics. Give her, say they, the benefit of the cork (in which the whole Admiralty has so suddenly acquired extraordinary faith), and although she would then be somewhere near the recognised limits of safety, and would be liable to the cork being more or less rapidly got rid of under shell fire, still the case is not so very bad after all. But unfortunately on reading further they come on the following page upon an ugly foot-note by Mr. Barnaby, bearing date June 25—one week after the occurrence of the *Inflexible* debate in Parliament—and in this foot-note is disclosed the fact that the figures which we have quoted, and which are given at p. 10 as expressive of the case when the unarmoured ends give no stability, turn out to be the figures applicable to the case when the cork is in place, and when the unarmoured ends are contributing the stability which arises from the cork! This is not clearly shown on the surface of the foot-note, but it has to be discovered in a roundabout manner. It can, however, be reached in this way. The foot-note implies that the cork was allowed for in the calculations of a certain curve given on the sheet of curves appended (Curve *e* in our present diagram), and by comparing this curve with the figures given on p. 10, we find that they express the same state of things, and thus we arrive at the fact that these figures likewise include the stability due to the cork. We do not propose to offer any comments upon this, except to say that we cannot help thinking that ninety-nine persons out of every hundred who read these papers will be completely mystified and misled by such an arrangement of the information, and more than all by the distinct employment of words which indicate that the cork is unaccounted for, when, in point of fact, the cork is accounted for.

By the means thus indicated we arrive at the fact that the amount of stability previously referred to and quoted is the amount which alone the ship was believed to possess when the First Lord of the Admiralty made his statement in Parliament, and declared that the Board were in every way satisfied with the vessel. It follows that the First Lord of the Admiralty was satisfied that the *Inflexible* should have a righting lever (G Z) less than six-tenths of a foot long with the cork in place, and of course with very much less in the event of the cork being blown out. We are not able to state—for the Admiralty does not give the information—how much stability the constructors and the Admiralty actually believed the ship to possess in the case under notice (viz., the case of the unarmoured ends really contributing no stability), but it is impossible to peruse these papers and to come to any other conclusion than that unless this information was advisedly kept back it ought to have been given. We cannot ourselves, of course, profess to say how much of the measure of stability which we have quoted was due to the cork, but we are able to approximate pretty closely to it by aid of the diagram which Mr. Reed prepared, and which is printed with the papers. That diagram Mr. Barnaby has marked "wrong," and no doubt it does differ a little from Mr. Barnaby's own diagram in its estimate of the amount of stability with the cork in. Indeed Mr. Reed only put his curve of stability forward as approximate, and as being in his opinion "pretty near the truth;" but this diagram may be taken as a sufficient approximate indication of the amount of stability actually due to the cork itself, and by taking that away from the Admiralty diagram we get what the Admiralty themselves would probably allow to be the state of the ship with the cork out. We have performed this operation, and we find that the *Inflexible* is, with the cork out, left almost absolutely without any stability whatever, even when she is judged by the diagram which the Admiralty themselves supply, and upon which they rested when the first Parliamentary debate took place.

Subsequently, that is on June 25, Mr. Barnaby put forward a memorandum (the foot-note before referred to) showing that his own previous diagram might be extended a few degrees by introducing such considerations as that the four guns had been increased by 20 tons each (in a ship of over 11,000 tons !), that the armoured deck was to be broken through to let the cables be stowed lower, and that an allowance might be made for immersed materials ; and by these means some little show of a curve of stability, even with the cork out, is obtained ; but the amount of it must be exceedingly small, as the range claimed is only 17 deg., and the curves which we give in the accompanying engraving indicate by analogy how very small the *amount* of stability must in this case be with so extremely limited a range. We feel bound, however, to demur to any such change in the Admiralty calculations, both because of the doubt which must inevitably rest on the alteration of calculations made to meet a public inquiry already commenced, and because the actual changes made in this case are in themselves improper. It is improper to make new allowances now ostensibly for the enlarged guns, because still larger guns were originally contemplated in the design, as the printed Papers clearly show ; it is improper to alter the cables to meet the present state of things, as they were obviously wisely placed in the first instance ; and it is improper for the sake of a small nominal increase in the apparent amount of stability of this ship to introduce novelties of calculation which will defeat all comparison now and hereafter between the *Inflexible* and other ships, and which will absorb into the substance of the calculations for this one ship those small outlying margins which together make up the dividing ground between safety and risk. For these good and sufficient reasons we stand upon those calculations on which Mr. Ward Hunt rested when he addressed Parliament on the subject, and we are obliged to state that, according to those official calculations, the *Inflexible* is practically without stability when the unarmoured ends have ceased to furnish any.



Range of Stability

DESCRIPTION OF CURVES.

		Angle of Max. Stab.	Max. G. Z.	Range.	Metacentre above C.G.
		°	Feet.	°	Feet.
b	Ship complete, Cork in place	31·2	3·28	74·3	8·25
d	As in *b* but in light condition	31·7	3·935	71·5	8·53
e	Fully equipped ; ends riddled	13·5	·568	30·0	2·0
f	As in *e* but coal between decks (800 tons) removed ...	15·4	·534	32·2	3·09
g	As in *e* but in light condition	20·8	·794	36·8	2·22
k	As in *e* but supposing the water in ship when upright locked	13·9	·705	32·0	
m	As in *k* but supposing main deck kept free of water ...	27·4	2·42	71·5	

The next question which arises is, how is the ship circumstanced with the cork in ? and the answer to that we have incidentally had before us already. Even by introducing such considerations as Mr. Barnaby adduces in the foot-note he only claims for his curve of stability with the cork in a range of 35 deg., and with the range so increased the righting lever G Z cannot much exceed six-tenths of a foot in amount. It will be easy for the reader of these remarks to imagine, without our assistance, the slight alteration of curve *e*, to which we are here pointing, and when they bring the eye down from the large levers of stability indicated by the curves *d*, *b*, and *m*, to the curve *e*, even when thus enlarged, they will see what a striking difference there is between the ship with her unarmoured ends intact and the ship with those ends broken into by the sea. The fact is that even in this state with the curve of stability extended by the devices to which we have already objected, the ship is in an unsafe condition when judged by the only standards that at present exist for our guidance, viz., those laid down in the Report of the Committee on Designs of 1871.

We have now almost exhausted all that the Parliamentary Papers contain on the essential question at issue, but before concluding this part of our subject we must advert to the case of the *Devastation*. The *Devastation*, as designed, had an unarmoured forecastle, which extended down to within about a foot of the water's surface, and with this forecastle perfect, she had a range of stability of 43½ deg. Mr. Barnaby alleges that with the forecastle perforated, her range of stability would be brought down to 35 deg., and that the maximum angle of stability would be 9 deg. It seems to us that the curves given show something more and something different to that which the table in the text gives. They show something more, because it is clear on inspecting that one which relates to the *Devastation* with forecastle perforated, that although the maximum appears to be reached at 9 deg., there is no perceptible diminution in the magnitude of the stability for nearly another 9 deg. The curve seems to be parallel to the base line, from 9 deg. up to 16 or 17 deg., and the state of the *Devastation*, therefore, is totally different from that which might be expected from the announcement in the text, that 9 deg. is the angle of maximum stability. But even allowing all the stability which the *Devastation* is shown to possess by these curves, we are ourselves disposed to believe that when this ship was altered, the alteration should have been so made as to add to the stability of the ship when the unarmoured bow is perforated. Now the Reports of the Committee on Designs show that the changes made after Mr. Reed left the service were of a kind which, while adding materially to the stability of the ship under ordinary circumstances, burdened her with a large amount of top weight, which, together with the lowering of the armoured freeboard, must have diminished the stability with the bow perforated. In view of this consideration, we should much like to have seen the *Devastation's* curve of stability as it would now be with the unarmoured bow perforated, for we are disposed to think that the production of that curve would disclose a much less satisfactory condition of things as regards stability in the *Devastation* as she now is, than existed at the time of her design; and, as we have already intimated, this ship appears to us not to have possessed even at first all the stability desirable. We are aware that the Committee on Designs expressed a contrary opinion, but we doubt if they duly considered the state of the vessel with the forecastle perforated, and we believe that if they had they would probably have looked less complacently upon the change that was made than they actually did. If we are right in this view of the *Devastation*, Mr. Reed must no doubt bear the blame of having cut this ship's stability somewhat finer than it should have been, and all that could be admitted in mitigation of the fact is that which he would probably plead, viz., that this ship was the first great monitor of the kind that had ever been designed; that calculations of stability at considerable angles of inclination had not then come into vogue; and that he left the service long before the *Devastation* was completed for sea; and therefore that it was not from his hands that she passed into actual service.

But it is no part of our business to distribute blame in such matters, and all that we can say on the point is that we are not satisfied even with the *Devastation*, and that whatever deficiency of stability she might have possessed as originally designed, that deficiency must have been made worse by the modifications which the ship has since undergone.

We must now say a few words upon the question of the cork, and how far it may really be relied upon for giving to the *Inflexible*—not a safe measure of stability when the unarmoured ends have ceased to furnish any otherwise, for we have seen that with all the cork in place the stability is still too little for safety—but some sort of chance of escaping that capsizing which must befall her at sea with the cork gone. The great advocate of cork is the present Director of Naval Ordnance, Admiral Boys; but if the arguments which he sets forth in these printed papers are in truth the foundations on which the hope of the Admiralty is based, their confidence must be very ill-grounded indeed. Admiral Boys is good enough to set forth in a formal manner the reasons which induce him to think the cork can be depended upon. There is one at least to which science at once supplies an answer.

He mentions "the difficulty of striking a ship at or below the water-line, particularly one of the *Inflexible* type, that will scarcely ever roll." Scarcely ever roll! A more astonishing, and may we say a more utterly groundless remark, was probably never made upon a serious subject. It has been established beyond all question or cavil that one of the most fruitful causes of rolling is great stability, and that mastless ships of great stability will roll more than any other. Now, in her uninjured state, which is the state in which she will enter upon an action, the *Inflexible* will have very large stability, and may be expected to roll heavily in a seaway. A glance at our engraving this week will show that the length of the righting lever, G Z, is sometimes over three feet, and in one case (with certain stores consumed) nearly four feet, whereas not one of all the typical curves given in our last number gives a G Z that much exceeds three feet, while all but one are much below that. It is true that the admission of water at the ends may have a perceptible effect in diminishing the rolling, but it would be premature to presume any great results in this respect. And apart altogether from the rolling of the ship, every seaman, including Admiral Boys, must be well aware that the ends of the steadiest ships in the world get much exposed by the mere falling away of the water in a seaway. With regard to Admiral Boys other assumptions they are more out of our province, but we may remark that the enunciation of such views by a high officer of the Admiralty is calculated to fill common minds with astonishment and apprehension. Naval architecture, instead of being a complex and difficult branch of science, would be of all arts the most simple and easy, if all that had to be done were to keep safe the under-water parts of ships that never roll; to encounter projectiles that cannot fulfil the object for which they are employed; and to engage vessels armed in the most suitable manner, and managed in the most suitable way, to let us escape!

The conclusions we have arrived at are, that the *Inflexible* is not a safe ship for battle in her present state;

that the objections brought against her have been much too lightly treated; and that the disclosure of her condition, with the circumstances that have followed it, have excited just surprise and dissatisfaction. The subject must be anxiously watched through its future stages.

THE NEW METEOROLOGICAL COUNCIL

THE final stage of the labours of the Treasury Committee, to which we have made frequent reference, has now been reached. The Royal Society has been appealed to to nominate the new council; they have done so, and the Government has accepted the nominations, which are as follows:—Prof. H. J. S. Smith, Savilian Professor of Geometry in the University of Oxford and Keeper of the University Museum (Chairman); Prof. Stokes, Lucasian Professor of Mathematics in the University of Cambridge, and Secretary of the Royal Society; Dr. Warren de la Rue, Mr. F. Galton, and Gen. Strachey, Member of the Indian Council. In addition to these there is Capt. Evans, the Hydrographer of the Navy, as an *ex-officio* member.

The new Meteorological Council, then, like the old Meteorological Committee, is composed of Members of the Royal Society, who severally hold distinguished positions in special departments of science, and who collectively represent considerable administrative ability. The addition to the new Council of two distinguished mathematicians and physicists, such as Professors Smith and Stokes, will be generally regarded with satisfaction, particularly when it is considered that it is to the mathematician and physicist that meteorologists must always look for information and guidance on many matters affecting the intricate and difficult problems with which they, in the position the science has attained, must now deal.

It is, however, matter of general surprise among meteorologists, or we should rather say of wide-spread regret, that the New Council will resemble the old Committee in having no meteorologist upon it. The omission, so far as concerned the Meteorological Committee, was a serious one, and led to mistakes; so far as concerns the new one it will be well if it does not seriously mar its usefulness and retard the foundation of the future science of physical meteorology. At the same time it is only just to point out that because the science is of the future, the choice of the Royal Society was small, and that considerations not on the surface may have had to be borne in mind. However this may be, there is no doubt that the Royal Society and the new Council have accepted a great responsibility, and that the action of the latter will be most keenly watched. The Royal Society, in a report to the Government, has stated:—

> "The Council of the Royal Society is of opinion that the most practical method of advancing meteorology is to endeavour by research and experiment to place that science on a firm basis. They are also of opinion that this can be done only by the devotion of the time of scientific men to the necessary research and experiment."

Men of science, therefore, will be justified in looking both for research and experiment from the new council in addition to the dreary piles of observations which have cumbered all scientific libraries for the last half-century.

And here is the rub. Will the busy—not to say already over-worked—members of the Council adopt this "practical method," and conduct researches? or do they propose to content themselves by going into the market with the 1,000*l.* which is given for *research*, and, be it remarked, not for mere *observations?* In the latter case it is to be hoped that their advances will be met in no narrow spirit; for if the new council only fosters research and experiment, it will be a great gain.

While, on the one hand then, we have a right to expect results of a high order from the new Council, on the other we are glad to see they are to be no longer an unpaid body. Besides the 1,000*l.* devoted to research there is another 1,000*l.* devoted to the payment of the members. This sum is to be spent partly in retaining fees and partly in payment for attendance.

The vote asked for the present year and agreed to on Tuesday is 10,000*l.*, and the Secretary of the Treasury then stated that the Committee had recommended an expenditure of 4,000*l.* a year by the Meteorological Council, and, in the judgment of the Treasury, the recommendation was one that ought to be adopted. A supplementary vote will be asked for this at an early date.

As regards the meteorological societies, on whom must devolve the practical working out of the large problem of the comparative climatology of the various districts of the United Kingdom—the working out of this problem being beyond the scope of the operations of the New Council just as certainly as it is beyond the resources originally placed at its disposal—we cannot but suppose that the Government have, in handing over the administration of the meteorological grant to the New Council, made provision that a portion of the additional 4,000*l.* will be spent in adequately aiding these societies in doing important national work which they are in a position to do so economically, and which, judging from the past, they can do so effectively.

This now seems to be the Treasury view, for in the warm debate very properly raised by the Scotch members in favour of the claims of the Scottish Meteorological Society, Mr. W. H. Smith stated that, as to the tests that ought to be applied in such cases, special regard ought to be paid to two points. The object to be attained ought to be distinctly national, and not one in which particular individuals or classes were concerned, and security ought to be taken that the persons who sought assistance were contributing largely to promote the object in view. There is no doubt that the Scottish Society satisfies both these requirements.

The Chancellor of the Exchequer also stated that it would be for the Council to consider how far they could avail themselves of the services of the Scottish Meteorological Society in the conduct of their business, and on what terms that assistance should be rendered.

The Council have lost no time in entering upon their duties, and it is devoutly to be wished that some sign may soon be given that if its constitution is not what was generally looked for, it is still well qualified to discharge its functions and to merit the confidence of meteorologists, although they have had so little to say to its appointment.